NONLINEAR INVERSE SCATTERING APPLIED TO CALCULATION OF THE EFFECTIVE PERMITTIVITY OF RANDOM COLLECTIONS OF SCATTERERS

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ABSTRACT

The effective dielectric. constant of a random mixture of two dimensional scatterers is found by a combination of forward and inverse scattering techniques. Without 10ss of generality in either the forward solution or inversion, we will assume that the scatterers have circular cress sections. The method is based on calculating the scattered field of the mixture using an arbitrary source configuration (normal plane wave incidence for convenience), and using the results, in a statistical sense, in an inverse scattering solution to retrieve a single scatterer. This scatterer is a cylinder with the same support as the mixture, and produces the same scattered field. The field is found by averaging the scattered fields due to many arrangements of the random mixture with given permittivity, radius, and location distributions. This would be similar to a Monte Carlo simulation. Previously, we have reported the results of this approach for the case where the dielectric constant distribution of the scatterers is such that the effective scatterer is weak. In this case, although the multiple scattering effects may need to be included in the forward solution, the inversion can be carried out using a linear algorithm, e.g., diffraction tomography. To obtain the forward solution that includes all the multiple scattering effects, we use the recently developed T-matrix type algorithms by Chew et al. (cog. , see Chew, W. C., *Waves and Fields in Inho . mogencous* Media. New York: Van Nostrand Reinhold, 1 W0). In this work, we consider the case where the scatterers are not weak, and hence nonlinear inversion must be carried out. We use the Born iterative method whereby Born-type iterations are carried out on the source-type integral equation for the scattered field. Although each iteration is linearized, the final solution is that of the nonlinear inversion problem. The forward and inverse scat tering algorithms will be briefly discussed, and results from mixtures with various parameters will be presented.

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